

12. *Some Field Notes on the Batrachia of the Cape Peninsula.*

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(With Plate XXXVIII and 8 Text-figures.)

WHEN nearly two years ago I commenced the study of the local Batrachia, I was struck by the paucity of the accessible literature thereon. Since then the field observations, from which the following notes are drawn, have formed a fascinating and healthful week-end hobby, in which the sharp eyes of my sons have materially helped. These notes are now offered, not as an exhaustive treatise, but as a small contribution to South African natural history. The fact that we have been lucky enough to come across several hitherto unrecorded species, and those within fifteen miles of Cape Town, may be taken as an indication of the enormous field for the amateur, as well as for the trained investigator, that lies in the sub-continent. That such a tiny district as the Cape Peninsula should contain almost the same number of species as the whole of Europe is an indication of the immense possibilities of South Africa.

Anatomical data of the species cited are on record elsewhere, and precise details of the tadpoles are outside the scope of this paper, and only details personally observed are included. The term Peninsula, except when used in contradistinction to the Flats, is taken to include the latter up to five miles from the mountains.

Rana grayi, Smith, shows a great variety of colours and markings, and is found everywhere in this district where there is grass, only resorting to water at the mating season. During dry seasons I have found it in earth-cracks two feet down. Voice, a sharp click, in course almost deafening. The male is much smaller than the female. Embrace axillary. Eggs deposited in temporary vleis and puddles in May and June: 1200 have been counted. The semilunar embryo is whitish; the tadpole at first is black, later of shades to some extent harmonising with environment. They vary a good deal in the size at which metamorphosis takes place, sometimes reaching 75 mm., at times changing at half that size. Colour changes appear to be

induced by light. A bright brown specimen kept in the dark for a time changed to a light fawn.

Rana fasciata, Boie, frequents long grass by running water, usually on hillsides, but is very numerous in a marsh near the shore at Witsands. Tadpole long and narrow, with yellow vertebral stripe. No voice noticed. Only a moderate swimmer. Has a habit of diving through the long grass rather than jumping over it.

Rana fuscigula, Dum. and Bibr. More aquatic, seldom noted except in pools or streams or on the banks thereof; highly cannibalistic. Voice, a harsh croak. The sticky spawn is found adhering to stones in streams, often in rapid torrents. The tadpoles may remain as such for two or more seasons. The largest I found was 112 mm. long, but metamorphosis may take place at less than half that size. I have often found them in mountain trickles barely deep enough to float them, metamorphosis then being very quick, complete froglets found in September being only 15 mm. from nose to vent.

Pyxicephalus delalandii (Tschudi) is found on sandy soil. Nocturnal, especially during hot weather. Buries itself by kicking backwards into the sand. Male voice a rapid tinkling cluck, "Tuckle-uckle-uckle," the female reply resembling nothing so much as the whine of a door-hinge. Embrace axillary. The small eggs number about 2500. The tadpole is shaped like a conventional heart, the small tail filling the notch. *P. delalandii* is second only to *Breviceps gibbosus* in distensibility. Changes colour similarly to *R. grayi*.

Rappia horstockii, Schleg., is rather plentiful in strictly localised areas: Retreat, Hout Bay, Strandfontein. Generally found in arums or amongst reeds by sluggish rivers; though, as I have found specimens soon after the commencement of the rains, miles of sandy ground from the nearest permanent surface water, and later on by the beds of recently dried pools, I suspect it can aestivate in the damper subsoil.

In my notebook, under 14th December 1924, I find the following: "Four *Rappia*, two on bushes by a sluggish ditch, and two on *Restio* about half a mile distant from the nearest surface water, sand dunes intervening. The day was scorching hot and they were in an entirely exposed position, but were quite moist and cool."

Its favourite site is in the arum bloom, at times two or even three together, the frogs being then an ivory-white colour; hands, feet, and inner parts of thighs bright pink. In other surroundings various shades of brown to mahogany are assumed; the changes, which may occupy a few minutes only, appearing to be a sight reflex. One specimen, when captured, was dark amber with bright green spots and green stripes

above and below the dark lateral stripe. When taken from specimen case it was dark mahogany with light spots, and after some time in the light was very light yellow-brown with no spots. Voice a low croak; chief activity at night. It is very active, leaping upwards of 24 inches and alighting with certainty and precision. A favourite habit is to leap with hind legs wide spread and, when even a single toe touches a reed or the edge of a bloom, to twirl round to the opposite side thereof, out of sight. When perched on even the thinnest grass-stalk, *Rappia* has its feet against and never clutching it. On a flat surface the normal rest position is as shown in the sketch, the hands and feet outlining the stomach and forming a chamber which probably assists adhesion. The male vocal sac is only noticeable at the breeding season, and is protected by a disc of thickened skin, of which, in over 200 living specimens, no suctorial function has been noted. It will be seen that the fingers pass across the vocal sac. The fingers show a vestige of web, the toes being half-webbed. It catches insects with extensile tongue, often leaping a considerable distance and catching them in its mid-flight. These frogs have a habit of sitting on top of one another for hours or even days at a time, sometimes three deep and always exactly dressed and centred. This position, which has nothing whatever to do with mating, is often taken up even when the lower one is in a vertical position, and has only been observed in the case of captive specimens.*

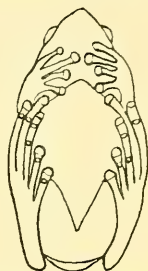


FIG. 1.—*Rappia horstockii*.
Natural size.

I do not consider that either *R. marmorata* or *R. undulata* occur in the Peninsula, and would similarly exclude *Megalixalus spinifrons*.

Cassina senegalensis, Dum. and Bibr., is secretive, inactive, and nocturnal; does not hop, crawls rather slowly, climbs a little, and is only a moderate swimmer, the feet being about $\frac{1}{6}$ webbed. I have obtained most of my specimens by breaking up the decaying roots of *Restio*, so common on the Flats, or by rearing from tadpoles. For such a slow, non-aquatic frog the tadpole is remarkable. It has a long and very broad and powerful tail, the membrane of which extends half-way up the body, dorsally and ventrally, which makes the swimming action very rapid and fish-like. There is a golden or silvery stripe 3 mm. wide along the axis of the tail, on either side. The tadpole grows to a considerable size, and all four limbs and body shape are fully developed before the tail shows the slightest sign of

* See Addendum on spawning, p. 450.

shrinking. When once the shrinkage commences it is very rapid,

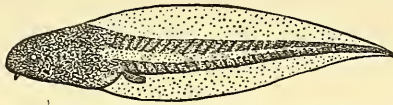


FIG. 2.—Tadpole of *Cassina senegalensis*.
About $\frac{2}{3}$ natural size.

considering the amount of material to be absorbed. A tadpole that had a tail 43 mm. long on 27th December showed only the barest stump on 30th December, the body being per-

ceptibly fatter, though no food was taken in the interval. I have noted the following weights and measurements:—

Measurements—

Length of adult	29 mm.
Tadpole, total length	67 ..
,, body length	24 ..
,, tail length	43 ..
,, depth of tail	15 ..

Weights—

Tadpole with four legs and full tail	25 grm.
,, ,, ,, ,, half tail	19 ..
,, practically tailless	15 ..
Adult	21 ..

The specimen described as adult was at least three years old, having been nearly two years in my vivarium, and was the largest of some twenty caught. A dead and dried specimen was found measuring 35 mm. nose to vent. The eggs are probably laid in October, as the first small tadpoles were found in mid-November and metamorphosis is complete about New Year. The vocal sound is a creak like that made by a basket. Embrace axillary. On the throat of the male all the year round is an ovate suction disc 7 mm. by 6 mm. I have noted an application of this when the frog is clinging to the side of a glass vessel, and suggest that it is used when mating, as accessory to the rather weak arms.

Microbatrachus capensis (Blgr.) may be found in small numbers in several places on the Flats, in one locality at least being very plentiful. Generally found round the edges of temporary vleis, but a few have been found in summer in decaying *Restio* roots. Great variety in colour is displayed and considerable individual change. Specimens coloured pale, bright, or dark green, grey, fawn, light or dark brown, russet or black, may all be found in the same pool. Some are uniformly coloured, in others a narrow vertebral stripe is constant; at times broad lateral stripes are seen. I have found a few speckled like

granite, and many have warty backs. Members of a large series may have nothing in common but size and shape. Bright light appears to induce the brighter shades. The belly also shows a great variety of mottling, marbling, blotching, or speckling, and is at times a plain brownish white. The feet show varying degrees of webbing up to $\frac{2}{3}$. Voice, a sharp "tschik, tschik," the male vocal sac being continued over at least half the ventral surface, practically doubling the body size, being comparable in this respect to *Hyla arborea* of Europe. The tiny eggs are deposited in June and July in clusters of about twenty, attached to grasses in shallow pools.

The embryo is semilunar and black. Tadpoles are proportionately large, the converted froglet which I have found on 7th December being little smaller than the adults.

Cacosternum boettgeri (Blgr.). Specimens referable to this species, though, as Mr. Hewitt informs me, not typical *boettgeri*, are only occasionally found on the Flats; generally in close association with *M. capensis*, from which a close scrutiny is required to distinguish them. On the largest specimens I have taken (19 mm. nose to vent, 35 mm. nose to toe) I could detect no trace of web. The stomach is white and is edged with small dark spots. *C. boettgeri* appears smoother and sits flatter than *M. capensis*, and the head is capable of—for a frog—a large extent of lateral movement. Only specimens of brownish colours have been found, the shades of which vary from time to time in the same individual. A broad dorsal stripe with a lighter vertebral streak is usually present. The breeding habits—practically identical with those of *M. capensis*—have been fully described (Hewitt and Power, Trans. Roy. Soc. S. Afr., vol. iii, p. 171).

Cacosternum capense, Hewitt. This species was described from one adult and one juvenile specimen only.* The advent of the rains, 10th June, and with them the breeding season of most of the Peninsula Batrachia, enabled me to secure a number of specimens in the type locality (Rondebosch Golf Links) and to make some notes thereon. On every occasion the numbers of males secured outnumbered the females by at least 6 to 1. The largest female was 38½ mm. from nose to vent, the largest male 32 mm. The female has a very conspicuous vocal sac which is quite black at this season. The voice varies, being at times a metallic "Tock, Tock," at times "Cree, Cree," more like a slate-pencil drawn perpendicularly across a slate. After the mating period little sound was made. The embrace was axillary, the male's nose being pressed hard down on to the female's head.

* Records of the Albany Museum, vol. iii, p. 367.

Nine mating pairs were isolated, the eggs numbering 140, 190, 141, 375, 209, 177, 57, 134, 400. The capsules measured 3 mm. across, and, though separate, were very sticky. The nucleus was white on one hemisphere and black on the other, and 1 mm. across. The embryo is quite white and semilunar. First froglets seen on 7th September. The gait is a series of short hops or rather flops, with now and again a short quick run. Swimming action not very strong, as they only enter the water at the breeding season. They sit very flat. Kept in a vivarium, with shallow water over sand, they lay for hours buried in the sand with the tip of the nose showing sometimes above, but more often below, the surface of the water. This habit, coupled with the fact that during the dry season they remain almost entirely underground, may account for their having escaped discovery until lately (July 1924). In living specimens the dorsal surface is distinctly warty, and in the changing tadpole and froglet these warts are brightly coloured, either green or orange. Above the sacrum appear two small soft tuberosities which, Mr. Hewitt informs me, are skin glands.

Cacosternum capense appears to emit a poisonous secretion, as on one occasion a *Rana grayi* and a dozen *M. capensis*, and on another, 19 out of 25 *Bufo rosei*, placed in the same vivarium, were found dead within a few hours.

Arthroleptella lightfooti, Blgr. Found in several gorges on the Peninsula mountains and, under entirely different circumstances, in a small marsh above St James. Probably at least two types occur. Considerable variety in colour and marked individual change was observed. The voice is a high-pitched chirp like that of a cricket. The largest specimen measured 21 mm. from nose to vent. The breeding habit is of interest. At the beginning of November, in damp moss beside a small waterfall—the favourite habitat—I found several small clusters of eggs, each consisting of five or six closely adherent globules of jelly with large white nuclei. The globules were large—8 mm. diameter—the nucleus being $4\frac{1}{2}$ mm. In some clusters could be seen tailed embryos that wriggled freely in the jelly when it was touched, whilst others showed an intermediate stage. Some were brought home and kept under observation. The embryos, at first white, soon turned darker, except the tail, which remained a translucent white throughout. At the time the hind limbs were appearing, the little larvae left the capsule and wriggled about in the moss. They were quite unable to swim, and died when left in water. Development proceeded very rapidly, the appearance of the fore-limbs and the

absorption of the tail taking place in a matter of hours. The whole time taken for the complete metamorphosis was from a week to ten days. No food was taken and no mouth could be seen, and the complete froglet was little, if any, bigger than the egg nucleus.

Although the little frog only kicked convulsively when placed in water, two left therein completely submerged were alive twelve hours later, the mouth, though then visible, appearing to be sealed up. The next day the froglets were, like the adults, extremely active, and commenced to feed on tiny insects.

Breviceps gibbosus, Linn., is found on the mountains and Flats, generally underground; often under termite or ant-heaps. Burrows by kicking outwards with hind legs and gradually turning round,



FIG. 3.—Stages in the development of *Arthroleptella*. All natural size.

always clockwise. It is generally supposed that members of this genus omit the tadpole stage, and doubtless the breeding habit of *B. gibbosus* resembles that of *B. mossambicus*, of which Mr. G. van Dam of Pretoria has kindly given the following details: "The eggs are large and comparatively few in number. These are deposited by the female in a small chamber, excavated under a stone, not necessarily anywhere near water. The complete metamorphosis takes place within the egg capsule, and the young *Breviceps* eventually emerge completely developed. The female parent remains in the vicinity throughout the period of incubation." I have lately found a specimen, on the Flats, of a *Breviceps* that appears to be well distinct from *gibbosus* in skin-surface, markings, subarticular and metatarsal tubercles, by the mouth being more ventral, by the width of the head being less than 25 per cent. of the body-length compared with 40 per cent. of *gibbosus*, and in being much more active.*

Bufo angusticeps, Smith. Very common in sandy localities from June to New Year, when it disappears. The eggs are deposited in strings during June and July, in puddles and temporary vleis; 650 and 850 have been counted. First complete toadlets, 10 mm. nose to vent,

* This specimen has been sent to Mr. Power, who pronounces it as deserving of specific rank. Descriptions of this and still another new species from Table Mountain are given in his paper on the genus which appears in this volume. The Peninsula will thus contain three species of *Breviceps*.

were seen on 30th August. In one taken on 29th July 1925 the stomach was found to contain 8 univalve molluscs, *Succinea delalandii*, and nothing else, a surprising diet for a toad that only frequents water at breeding season. Embrace axillary. Voice, "Gaa, Gaa, Gaa," slowly. Male throat not darker.

They are moderate swimmers; hop, or run, when alarmed, but the usual gait is a walk. In general appearance, habitat, and habits *B. angusticeps* much resembles *Bufo calamita* of England. Inner side of hind limbs is yellow.

Bufo regularis (Reuss), as found in the Peninsula, is a brilliantly coloured toad of large size. The upper surface is golden brown, olive green, or, occasionally, a vivid wine colour, with a bright yellow reticulation, more or less symmetrical, on either side of a vertebral stripe. The paratoid glands and the skin above the eyes and nose are brick-red. The yellow reticulation and stripe are constant, and though broader in juveniles (which could be described as yellow with patches of the colours mentioned above) are persistent. Specimens collected in the Paarl district differed so much in appearance from the Peninsula type that for some time I regarded them as specifically different. Juveniles dorsally were silvery grey with grey-brown patches. The upper surface of the nose between the eyes, the upper edge and anterior half of the eyelids, the paratoids, and a triangular patch on the back—the size of the nose, and forming therewith, as it were, opposite corners of a square—were brick-red. The adults, whose warts, as compared with the Peninsula type, were large and relatively few, were all a uniform brownish grey, the very slightly darker patches being barely discernible. The largest found was 82 mm. from nose to vent. A pair were taken spawning in the fairly rapid Berg River in January. The strings of spawn were drifting down-stream amongst the stones, no effort being made to entwine them amongst the reeds. Our local *regularis* spawns in August in vleis. The embrace is axillary. Last year I found a pair *flagrante delicto*, and secured the whole family. The male was 98 mm., and the female 137 mm., from nose to vent. The eggs in strings, which were only very slightly involved in the weeds, numbered 24,400, the last section—passed at home—having a club-shaped end. The tadpoles do not grow to any size, and the complete toadlets, found in mid-December, were only 12 mm. long. Some juveniles taken $8\frac{1}{2}$ months later were from 27 mm. in length. Despite the numerous progeny, this toad is comparatively rare compared with *angusticeps*. This is probably due to its longer larval life subjecting it to the attacks of

numerous enemies, notably dragon-fly and other insect larvae; and perhaps in part to the cannibalistic habits of the species, young and old. I have seen a large specimen devour full-sized *R. grayi* and *B. angusticeps*, and its own kind as large as 70 mm. body-length, and on one occasion a 7-inch *Mabuia trivittata*. In taking this larger prey, *regularis* stands right over it and strikes down with open mouth and no noticeable tongue-extension. The male vocal sac distends to the size of a walnut, the voice being a harsh "Waak, waak." The usual gait is a walk or a surprisingly long jump, never a run. A moderate swimmer.

Bufo rosei, Hewitt. I have found these little toads in a small marshy area at an altitude of about 1500 feet above Muizenberg; in close association were found *Rana fuscigula*, *R. grayi*, *R. fasciata*, and a small frog of the *Arthroleptella* genus (gen. nov. Hewitt). The surrounding hillside was bare and rocky, and no toads were found more than a few feet from the marsh.

A fair number of specimens was obtained, chiefly under overhanging grass tufts; in all sizes from 5 mm. to 26 mm., which latter I consider the full adult size. They exhibit all the typical characteristics of toads as to gait, swimming action, and habits; and live well in a small vivarium, feeding freely on flies, which they catch with extensile tongue.

In colour dorsally they are dark grey with three light grey longitudinal stripes, the parotid glands being dark orange. At times the whole dorsal aspect is black, the markings being then either invisible or barely discernible. The belly is greyish white. Compared with most other toads, *B. rosei* has quite a defined neck, and the head is capable of a fair degree of lateral movement.

I have also found this toad in some numbers by small streams at Jackals Drift, a second locality. No spawn definitely attributable thereto has so far been found, though I refer to this species some thick (4 mm.) non-indented ropes of spawn with large nuclei (2 mm. diameter and four to the centimetre) found in the vicinity. I suggest that careful search of the mountains of the mainland will prove that this little toad has a fairly wide range at altitudes above 1000 feet.

Heleophryne rosei (Hewitt) was fully described by Mr. Hewitt.* In all, we have caught 6 adults and 15 juveniles in Skeleton Gorge on Table Mountain. All were found under stones in or beside the rushing stream. Tadpoles, which are distinguished by a remarkable suction disc around the mouth, were plentiful under rocks, to which they

* Records of the Albany Museum, vol. iii, p. 363.

closely adhered; and a number were induced to complete their metamorphosis in an irrigated aquarium. It is certain that they may, and probably always do, pass at least two seasons as tadpoles. They are never observed swimming unless disturbed, when a quick dart is made to another anchorage. In the aquarium the suction disc could be well observed through the glass, the tadpole moving forwards from time to time as it devoured the algae. The colour dorsally is dark green. The skin on the ventral surface is so thin that the gills and viscera show clearly, red and black respectively. The spiracle is sinistral and very conspicuous. The maximum length is 47 mm., of which the head is 10 mm. and the body $9\frac{1}{2}$ mm., the head being $9\frac{1}{2}$ mm. wide. Tadpoles taken on the opposite side of Table Mountain and referred to this species were of a light amber

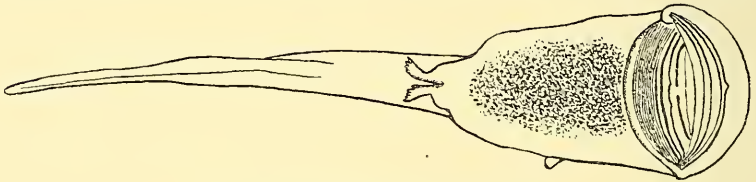


FIG. 4.—*Heleophryne rosei* tadpole.

colour, very young ones being transparent. Large yellow eggs dissected from a female resembled those obtained similarly from a *Breviceps*, and though I have never actually found eggs, I suspect that they are deposited in a hole in the river bank and—judging by the date the tiny tadpoles were found—early in June. The adults, of which the largest males and females were 41 mm. and 63 mm. respectively, are nocturnal, and I consider decidedly aquatic. They remained for hours submerged in the tank of a vivarium, taking no interest in an aloe—despiked—growing beside it; though later they hid in hollows at the roots. I have noticed that, when sloughing, the skin is allowed to float away piecemeal, the frog making no effort to hasten the process. When under water the eye is covered by a thin transparent membrane. The iris is green, the pupil diamond-shaped. On one occasion a *H. rosei* was heard to give a chirp, but no other vocal sound has been heard. I could not induce them to eat insects, and suspect that their food is aquatic crustacea and larvae. Some *H. purcelli*, captured in a similar locale near Groot Drakenstein and kept in the same vivarium, though remaining under stones in the tank for three days after capture, later on were often found perched on a horizontal branch. They jumped readily at flies, and are perhaps

more arboreal than *rosei*, as the thicker-skinned granular belly suggests; but they certainly did not display anything of that grace and agility in leaping and climbing which is seen to such advantage in the European tree-frogs and our local *Rappia*. The dorsal colours of *rosei* are dark green reticulated with dark brick-red, the ventral surface whitish, the abdominal viscera showing through the smooth skin. In *purcelli* the dark green is more extensive, the reddish markings appearing only as spots. *Purcelli* tadpoles are light amber spotted with black, stomachs quite white.

Xenopus laevis (Daud.). A good deal has been written about this frog and its tadpole, but most accounts appear to emphasise its essentially aquatic habits and predilection for deep rivers, ponds, and

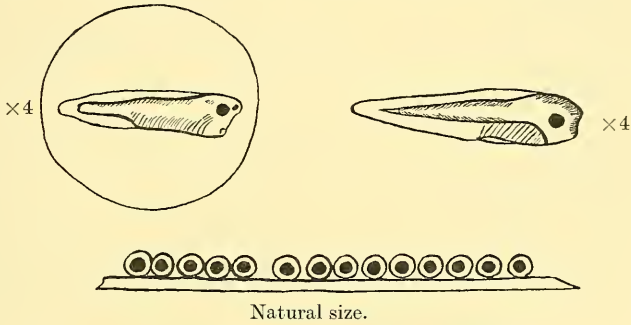


FIG. 5.—Eggs and tadpoles of *Xenopus laevis*.

dams. Large stretches of the Cape Flats consist of rolling sand dunes, the hollows between which—for half the year dry sand—the June rains convert into small pools a few inches deep. It is hardly conceivable that any Plathander, even if it so desired, could reach these pools from permanent water which may be several sandy miles away, yet in mid-July well-grown tadpoles can be found. Also I have found hundreds of juveniles huddled together in the last remains of a nearly dried vlei, so close that scores were caught by pulling a small bag through the water. The situation was such as to make migration out of the question. My notes state: “April 6th, about 200 Plathanders caught in a pool about 6 square feet in size, as many more being left.” This year, just before the rains, I dug up a *Xenopus* from the same locality. Apropos of this specimen, I suggest with all reserve the possibility of there being another species of *Xenopus* on the Flats. This specimen—and a dozen others found since—in my opinion differed from the normal on the following points: Nose

sharper, teeth much longer, hind limbs proportionately longer, feet not quite so fully webbed, eyes smaller, and tentacles not apparent, having in the mouth a peculiar organ that could most appropriately be described as having the appearance of a posteriorly attached tongue or a deflated air-sac. The stomach was brownish. Length, nose to vent 56 mm., nose to toe 120 mm.

The eggs, which continue to be deposited until August, are 3 mm. across. Nucleus 2 mm. They are attached in single file, touching, along one side of stalks of grass or water-weed. The tadpole is complete in a week and for another week remains absolutely motionless, head upwards, at or near the surface. Later they are always seen

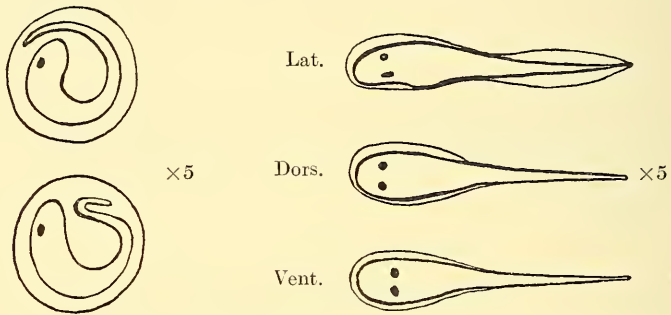


FIG. 6.—Tadpoles described on p. 445.

vertically, head downwards, maintaining position by movement of the very tip of the tail, the wide soft mouth apparently sucking in minute animalcules. The first complete froglets were found on 28th October, but in deeper water the tadpoles may be found till much later.

The Plathander has a peculiar habit of forking its food into its tongueless mouth with its long fingers, at times actually grasping the prey therewith before seizing it with the mouth. The diet is worms, insects, small frogs, tadpoles, and small fish. When under water the eye is often covered from below by a transparent nictitating membrane. By keeping *Xenopus* in glass jars surrounded by black and by white paper I have induced marked corresponding colour changes. It is, I think, known that the Plathander can survive in brackish water. A half-grown specimen was placed in 62½ ounces of water and 60 grains of sodium chloride was added each day. It was not until 360 grains had been added that the frog showed signs of discomfort, the altered density of the water preventing it from leaving the surface except by an effort. No more salt was added, but death

ensued four days later. The body had a stiff leathery feel and the skin was quite devoid of slime. I have frequently found *Xenopus* in close association with *M. capensis*, which is surprising in view of the former's habits. In or by one small sand-dune vlei, a few inches deep, on one day lately I found *Xenopus*, *R. grayi*, *R. fuscigula*, *B. regularis*, *B. angusticeps*, *R. horstockii*, *C. boettgeri*, *M. capensis*, *P. delalandii*, and a *Breviceps*.

Recently (21st June 1925) I found near Jackals Drift several clusters of frogs' eggs of a type that I cannot refer to any known species, except by presumption of an aberrant habit. These eggs, which were not in any degree adherent, were deposited to the number of 100 or so in small cup-shaped depressions in grass tufts or between them, which had the appearance of having been formed by the parents. A hundred or more eggs—diameter 3–4 mm., nucleus 2 mm.—were in each cluster, in some cases 50 per cent. being unfertile and of a milky opacity. A very transient puddle containing some toad spawn was near at hand. Most of the eggs in these clusters, which could never have been in water, contained a fully developed tadpole which wriggled slightly within a transparent capsule, which offered considerable resistance to pressure, and reminded one of a fortune-teller's crystal. Some were placed in water and some kept on damp earth. In both cases a tadpole—7 mm., of which the tail was 4 mm.—emerged in a few days, swimming strongly or wriggling in the mud, leaving a distinct empty envelope. After a few days, owing to the difficulty of keeping the mud in the vessel uniformly moist, I transferred all to water. In the capsule, and for some days later, no mouth could be discovered with a $\times 20$ lens, though two small circular spots, on the ventral aspect, that I took to be gill orifices, could be seen. The iris was golden and the pupil round. Surrounding the whole body, a transparent envelope could be detected.

In a few days more the usual tadpole mouth appeared, and up to the present the tadpoles are not very distinctive. Identification must await complete metamorphosis;* but I may mention that as the result of a thorough search, including digging, only *Rana grayi* were found, but no normal spawn nor tadpoles thereof, though in other localities every puddle swarmed with the latter.

* Since the above was written a number of tadpoles have completed their metamorphosis, but no difference can be detected between them and normal *R. grayi*; the conclusion being that certain of this species have developed an egregious metamorphosis. The only vlei in the vicinity, though some miles from the sea, was strongly saline.

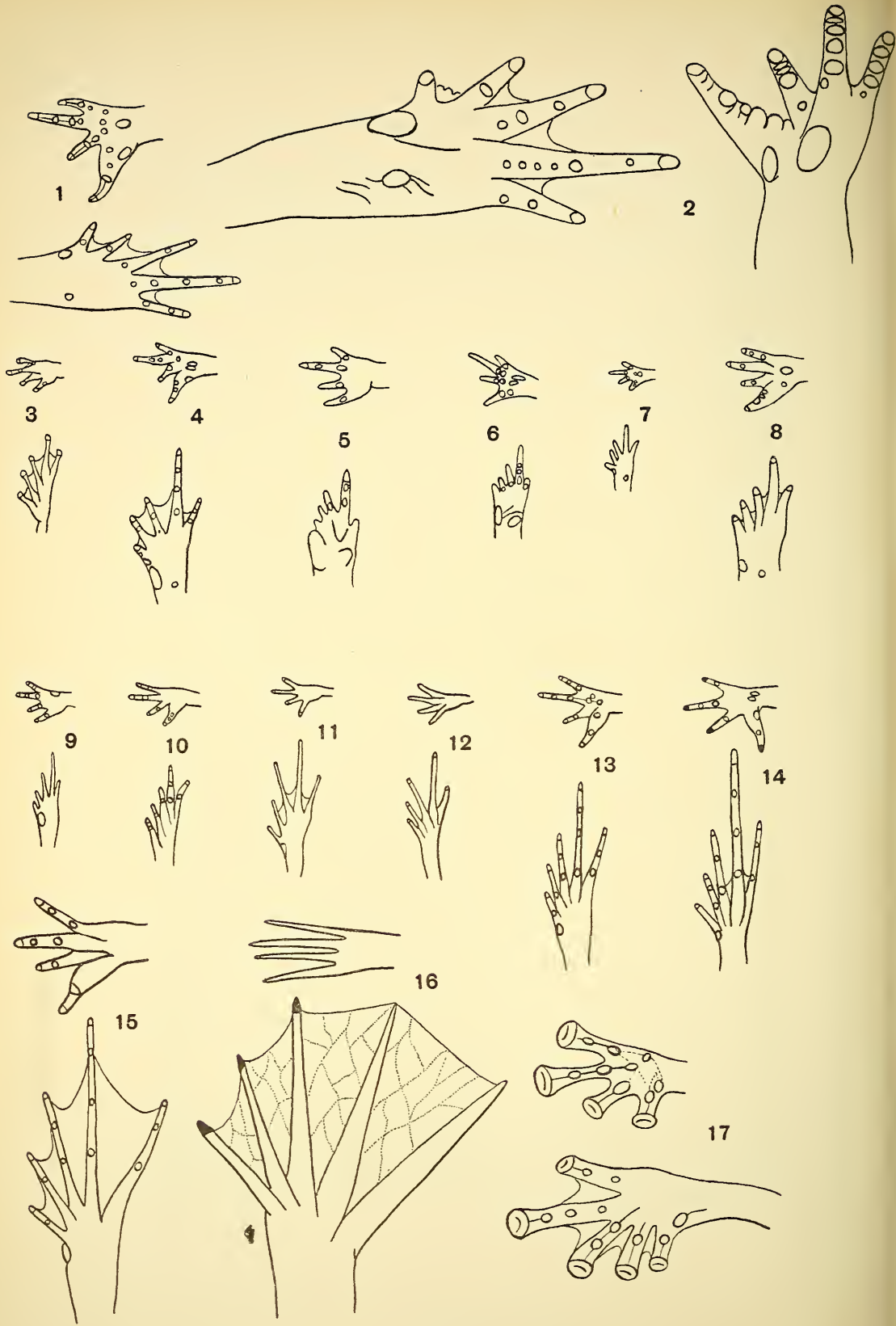


FIG. 7.

EXPLANATION OF TEXT-FIGURE 7.

Under-surface of left hands and feet of Peninsula Batrachia. All of the natural size except two.

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|---|---|
| 1. <i>Bufo regularis</i> , mainland type. | 10. <i>Cassina senegalensis</i> . |
| 2. „ „ Peninsula type. | 11. <i>Microbatrachus capensis</i> . × 2.* |
| 3. <i>Rappia horstockii</i> . | 12. <i>Arthroleptella lightfooti</i> . × 2. |
| 4. <i>Pyxicephalus delalandii</i> . | 13. <i>Rana grayi</i> . |
| 5. <i>Breviceps gibbosus</i> . | 14. „ <i>fasciata</i> . |
| 6. „ sp. | 15. „ <i>fuscigula</i> . |
| 7. <i>Bufo rosei</i> . | 16. <i>Xenopus laevis</i> . |
| 8. „ <i>angusticeps</i> . | 17. <i>Heleophryne rosei</i> . |
| 9. <i>Cacosternum capense</i> . | |

To summarise : the local Batrachia that resort to water for breeding only are *Rana grayi*, *Cassina senegalensis*, *Pyxicephalus delalandii*, *Cacosternum capense*, *Bufo regularis*, *Rappia horstockii*, and, remaining in water somewhat longer, *Microbatrachus capensis* and *Cacosternum boettgeri*. Except *R. grayi*, the above practically disappear during dry months. Found by permanent streams are *Rana fasciata*, *Bufo rosei*, *Rana fuscigula*, *Arthroleptella lightfooti*, and *Heleophryne rosei*, the last being confined to mountain gorges. *Xenopus* frequents sluggish rivers and vleis, both temporary and permanent.

In *Pyxicephalus delalandii*, *Cacosternum capense*, *Cassina senegalensis*, *Arthroleptella lightfooti*, and *Microbatrachus capensis* the male throat is very dark, especially during breeding season. In *Rana grayi*, *Rappia horstockii*, *Bufo regularis*, and *R. fuscigula* less but noticeably so ; in the others I have not observed any difference.

Individual colour changes are very marked in *Microbatrachus capensis*, *Xenopus laevis*, *Arthroleptella lightfooti*, *Rappia horstockii*, *Pyxicephalus delalandii*, *Cassina senegalensis*; somewhat less so in *Bufo angusticeps*, *Bufo rosei*, *Rana fuscigula*, and *Rana grayi*; and little or none noted in *Bufo regularis*, *Breviceps gibbosus*, or *Heleophryne rosei*.

I have found free-swimming tadpoles of all except *Arthroleptella lightfooti*, *Breviceps gibbosus*, *Rappia horstockii*,† and, to be positive, *Bufo rosei*; and spawn of all except the last three and *Rana fasciata*, *Heleophryne*, and *Cassina senegalensis*. I do not think, however, that any but the first two, and probably *Heleophryne rosei*, depart from the usual habit.

The local distribution, based on a very thorough search and in most cases many scores of captures, may be given as follows :—

Flats and low-lying parts of the Peninsula only : *Xenopus laevis*,

* Feet of *Cacosternum boettgeri* practically identical but lack the web.

† See Addendum, p. 450.

Cassina senegalensis, *Rappia horstockii*, *Microbatrachus capensis*, *Cacosternum boettgeri*, *Cacosternum capense*, *Pyxicephalus delalandii*, and *Bufo angusticeps*.

On high ground only: *Bufo rosei*, *Arthroleptella lightfooti*, and *Heleophryne rosei*.

On both: *Bufo regularis* (one only from the mountain), the three *Ranae*, and *Breviceps gibbosus*.

Markedly cannibalistic are *Bufo regularis*, *Xenopus laevis*, and *Rana fuscigula*; the others seldom depart from the usual Batrachian diet of insects.

There is no Peninsula species the spawn of which floats in water like that of *Rana temporaria* of Europe.

I think only approximate times can be assigned to the various stages of the free-swimming tadpoles, and only minimum times are worth recording, food-supply, light, depth, and temperature of the water being determinative factors; but, as would be expected, species such as *Rana grayi*, *Pyxicephalus delalandii*, *Bufo angusticeps*, and *Cacosternum capense*, which spawn in the nearest puddle, have the shortest larval life (except *Arthroleptella lightfooti*). *Bufo regularis*, *Microbatrachus capensis*, and *Cassina senegalensis*, which choose the larger temporary vleis, come next, and so on. I believe that, under a certain maintained condition of the above factors, the tadpoles of many species could be kept almost indefinitely as such. Observers up-country should bear in mind the reversal of the rainy seasons, our rains commencing in June.

A point that I have noted as persisting in a large number of widely separated South African species is a dark mark shaped like a boomerang on the head, concavity forwards, and ends extending over the eyes, and sometimes divided in the centre. Its significance may or may not be protective concealment, but its frequent occurrence is remarkable.

On the opposite page are drawings of the left eyes of the Peninsula Batrachia, made from living specimens. The eyes of preserved specimens often show an unnatural shape, as was brought to my notice in the case of *Bufo angusticeps* by Mr. Hewitt. All the drawings were made under the same light conditions, but it should be remembered that the irides of the more nocturnal species may show a disproportionate contraction.

Sizes of the various species in millimetres, mostly maximum (nose to vent and nose to toe respectively), are as follows: *Rana grayi* 42 and 115; *R. fasciata* 47 and 142; *R. fuscigula* 95 and 245; *Py. delalandii*

48 and 113; *Rappia horstockii* 35 and 84; *Cassina senegalensis* 29 and 67; *Arthroleptella lightfooti* 20 and 41; *Microbatrachus capensis* 20 and 37; *Cacosternum capense* 38 and 75; *C. boettgeri* 19 and 35; *Breviceps gibbosus* 48 and 65; *Breviceps* sp. 38 and 68; *Heleophryne*

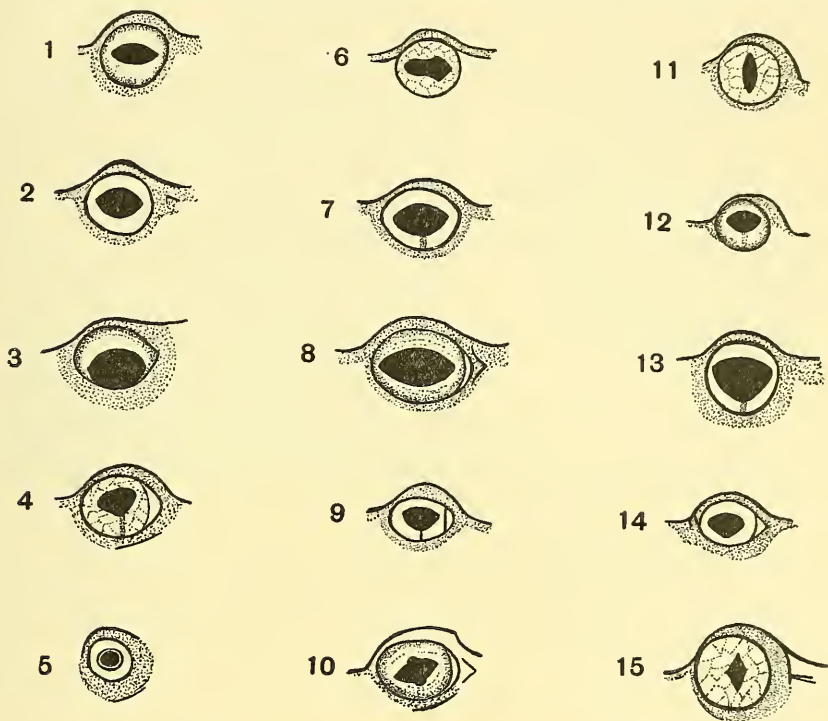


FIG. 8.—Left eyes of Peninsula Batrachia.

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|--|--|
| 1. <i>Cacosternum capense</i> . ×2. | 9. <i>Rana grayi</i> . ×2. |
| 2. <i>Bufo rosei</i> . ×3. | 10. <i>Bufo angusticeps</i> . ×2. |
| 3. <i>Breviceps</i> sp. ×2. | 11. <i>Cassina senegalensis</i> . ×2. |
| 4. <i>Pyxicephalus delalandii</i> . ×2. | 12. <i>Rana fuscigula</i> . Natural size. |
| 5. <i>Xenopus laevis</i> . Natural size. | 13. <i>Arthroleptella lightfooti</i> . ×5. |
| 6. <i>Rappia horstockii</i> . ×3. | 14. <i>Rana fasciata</i> . ×2. |
| 7. <i>Microbatrachus capensis</i> . ×5. | 15. <i>Heleophryne rosei</i> . ×2. |
| 8. <i>Bufo regularis</i> . Natural size. | |

rosei 60 and 165; *Bufo angusticeps* 68 and 110; *B. regularis* 137 and 260; *B. rosei* 26 and 50; *Xenopus laevis* 105 and 198.

In conclusion, I wish to record my great appreciation of the helpful advice and encouragement given to me by Dr. K. H. Barnard, Mr. J. Hewitt, and Mr. J. H. Power, without which these few notes could never have been attempted.

EXPLANATION OF PLATE XXXVIII.

- Left above : *Cacosternum capense* (male above).
Left below : *Bufo regularis* (Paarl type). $\times \frac{5}{7}$.
Right above : *Bufo regularis* (Peninsula type), young.
Right below : *Bufo regularis* (Peninsula type). $\times \frac{2}{5}$.
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ADDENDUM to p. 447 : spawning of *Rappia horstockii*.

Early in November, captive specimens deposited spawn in clusters of from 10 to 30 eggs attached to the roots of water-weeds (Canadian Water Hyacinth). The jelly capsule was 4 mm. in diameter, and the nucleus, which was white on one hemisphere and russet-brown on the other, was 2 mm. across. The tadpoles, which were not successfully reared, were translucent, with a decided brown pigmentation.